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IMPROVED MESSAGE ACCESS FOR RADIO TELECOMMUNICATIONS SYSTEM

This invention relates to an improved message access arrangement for a radio telecommunications system such as Universal Mobile Telecommunications System (UMTS) and relates especially to message acquisition indications.

To make a connection to the UMTS system, in known arrangements a mobile telephone sends its preamble at a first power, and waits for an acquisition indication on the Acquisition Indication Channel (AICH); if no indication is received, the preamble is resent at increased power, in steps, until an indication is received on the AICH. The message is then sent and if no positive acknowledgement is received via the Forward Access Channel (FACH), the message is assumed to be corrupted and it is resent. The total time spent by the mobile in waiting for acknowledgements can be considerable.

Further, checking of received preamble and message involves the Physical Layer (layer 1) and the Data Link Layer (layer 2) of the node (?) handling the connection; layer 2 may be located in the Base Transceiver Station (BTS) but it may alternatively be located in the Base Station Controller (BSC); the total time required for the messages to pass can add to the waiting time.

In WO 98/18280 Ericsson there is disclosure of a mobile station transmitting a random access request frame, which includes an error deduction redundancy field, but there is no specification as to when and to where the result of the error detection field test is sent.

ART 34 AMDT

It is an object of the invention to provide an arrangement in which the waiting time which a mobile may experience before its call is successfully connected is reduced.

According to the invention, a radio mobile telecommunications system comprising a base transceiver station arranged to manage a plurality of mobile systems within at least one telecommunications cell; the base station having means to provide an acquisition indication channel by which preamble signals sent by a mobile system to the base transceiver station are acknowledged when the strength of a preamble signal reaches a predetermined level, characterised in that the acquisition indication channel is further arranged to acknowledge message signals sent by said mobile system.

In the accompanying drawings, the prior art is illustrated in figures 1 – 7 in which:-

Figure 1 is a schematic diagram of a part of a radio telecommunications system;

Figure 2 illustrates a physical random access channel slots structure;

Figure 3 illustrates the structure of a random access transmission;

Figure 4 illustrates the structure of an access burst from a mobile;

Figure 5 illustrates the message part of the random access burst;

Figure 6 illustrates the layers involved in message acknowledgement and

Figure 7 illustrates how random access acquisition indication and forward access channels interact to acknowledge preamble and message signals from a mobile.

The invention will be described with reference to figures 8 and 9 in which :-

Figure 8 illustrates how the random access and acquisition indication channels interact to acknowledge preamble and message signals from a mobile; and

Figure 9 illustrates the new message route.

In Figure 1, a part 10 of the UMTS is illustrated, comprising a plurality of mobile systems (MS) 12, 14, 16 associated with a telecommunications cell controlled by a Base Transceiver Station (BTS) 18 having a Base Station Controller (BSC) 20.

When a mobile such as 12 wishes to make a call, it utilises the Random Access Channel (RACH) of the UMTS which is mapped to the Physical Random Access Channel (PRACH). Transmission in this transport channel is based on the well known slotted Aloha approach, that is, a mobile can start a transmission of the PRACH at any one of a number of well defined time offsets, denoted access slots AS and illustrated in Figure 2. The slots are spaced 1.25 milliseconds apart. Several of the slots in Figure 2 are shown as filled by random access transmissions 30, 32, 34, 36.

Figure 3 illustrates the structure of a Random Access Transmission such as transmission 30; there are several preamble parts 40a, 40b. 40i, each of length 1 millisecond, and an access burst 42 which contains the preamble part, plus a message part of length 10 milliseconds.

Figure 4 shows the structure of the access burst 42. Between a preamble 40j and the message part 44 there is an idle time period of length 0.25 milliseconds. This idle period allows for detection of the preamble part and subsequent online processing of the message part.

Figure 5 shows that the RACH message part 44 consists of a data part 46, corresponding to the uplink Dedicated Physical Data Channel (DPDCH) and a layer 1 control part 48, corresponding to the uplink Dedicated Physical Control Channel (DPCCH). The data and control parts 46, 48 are transmitted in parallel.

The data part 46 carries layer 2/layer 3 messages requesting radio resources or a user packet. The spreading factor of the data part is limited to $SF \varepsilon \{256,128,64,32\}$ corresponding to channel bit rates of 16, 32, 64 and 128 Kbps respectively. The control

part 48 carries pilot bits 50 and rate information 52, using a spreading factor of 256. The rate information indicates a spreading factor of the channelisation code which is used on the data part.

For RACH transmission, the technique of preamble power ramping is used, and the procedure used by a random request has the following actions:-

1 After cell search and synchronisation, the mobile 12 reads the Broadcast Control Channel (BCCH) (not illustrated) to get information about

i the preamble spreading code(s)

ii the available signatures

iii the available access slots

iv the available spreading factors for the message part

v the uplink interference level in the cell

vi the primary CCPCH (Common Control Physical Channel) transmit power level

2 The MS selects a preamble spreading code and thus the message scrambling code.

3 The MS selects a preamble signature and uses it to determine the primary node of the channelisation codes used by the message part of the access burst.

4 The MS selects a channelisation code (corresponding to a spreading factor) for the message part.

5 The MS estimates the downlink path loss (by using information about the transmitted and received power level of the primary CCPCH), and determines the required uplink transmit power (by using information about the uplink interference level in the cell).

6\. The MS implements the dynamic persistence algorithm by:

- Reading the current dynamic persistence value from the BCH.

- Performing a random draw against the current dynamic persistence value.
- Deferring transmission for one frame and repeating step 6 if the result of the random draw is negative, otherwise proceeding to step 7.

7. The MS randomly selects an access slot from the available access slots.

8. The MS transmits its preamble at a negative power offset relative to the estimated uplink transmit power. This is illustrated at reference 60 in Figure 7.

9. The MS waits for an acquisition indication (on the AICH) from the network side. If none is received within a predefined time-out period, the MS transmits the preamble again but with a smaller power offset and a re-selected preamble signature, reference 62, showing the higher power.

10. Step 8 is repeated, reference 64, showing a further increase in power, and an acquisition indicator 66 is received from the network side that indicates the acceptance by the network side of the preamble at that power offset. The acquisition indicator 66 is received on the AICH.

11. If an acquisition indicator is received on the AICH in Step 9, the random access burst is transmitted in the next available access slot. This burst comprises a repeated preamble 64A and a message 68.

12. If the message 68 is corrupted, as indicated by the dotted lines, then there is no positive acknowledgement and actions 1 to 11 are repeated, references 70 to 78; message 78 is successfully received, and an acknowledgement 80 is sent from the network on FACH.

Referring again to Figure 6, actions 1 to 12 involve the physical layer L1 of the MS 12, the physical layer L1 of the BTS 18, and the physical layer L1 and the Data Link Layer L2 of the BCS 20; a Cyclic Redundancy Code (CRC) check is applied by the BTS 18 in

layer L1, but the outcome is sent to layer L2 of the BSC 20, which puts the positive acknowledgement 80 onto the FACH.

When the message is corrupt, 68, layer L2 of the BSC 20 does not send acknowledgement 80.

It is clear that the Waiting Time (WT) of the MS12 before successful connection can be long; this applies even when the message is not corrupted.

Turning now to the invention, Figure 8 shows similar integers to Figure 7, advanced by 100, and actions 1 to 11 occur as in the prior art, integers 160 to 168. However, when the corrupted message 168 is received, a negative acknowledgement 171 is sent to the MS12 by the BTS 18, and actions 5 to 11 are repeated. If there is no negative acknowledgement 171, the MS 12 assumes that the RACH transmission has been successful.

Figure 9 illustrates that, with application of the invention, the longer route to the BSC 20 and its layer L2 is no longer involved, and thus considerable time is saved.

Further, since a negative acknowledgement message 171 is sent only in the relatively rare case of a corrupted message, traffic volume over the air interface is reduced. Also, sending the signal 171 avoids the time-out present in the prior art arrangement.

While the AICH could be arranged to send positive acknowledgement signals after CRC checking of a message, the advantage of a reduction in traffic volume would then not be achieved.